Medical Errors Related to Discontinuity of Care from an Inpatient to an Outpatient Setting

Carlton Moore, MD, Juan Wisnivesky, MD, Stephen Williams, MD, Thomas McGinn, MD

OBJECTIVE: **To determine the prevalence of medical errors related to the discontinuity of care from an inpatient to an outpatient setting, and to determine if there is an association between these medical errors and adverse outcomes.**

PATIENTS: **Eighty-six patients who had been hospitalized on the medicine service at a large academic medical center and who were subsequently seen by their primary care physicians at the affiliated outpatient practice within 2 months after discharge.**

DESIGN: **Each patient's inpatient and outpatient medical record was reviewed for the presence of 3 types of errors related to the discontinuity of care from the inpatient to the outpatient setting: medication continuity errors, test follow-up errors, and work-up errors.**

MEASUREMENTS: **Rehospitalizations within 3 months after the initial postdischarge outpatient primary care visit.**

MAIN RESULTS: **Forty-nine percent of patients experienced at least 1 medical error. Patients with a work-up error were 6.2 times (95%confidence interval [95% CI], 1.3 to 30.3) more likely to be rehospitalized within 3 months after the first outpatient visit. We did not find a statistically significant association between medication continuity errors (odds ratio [OR], 2.5; 95%CI, 0.7 to 8.8) and test follow-up errors (OR, 2.4; 95%CI, 0.3 to 17.1) with rehospitalizations.**

CONCLUSION: **We conclude that the prevalence of medical errors related to the discontinuity of care from the inpatient to the outpatient setting is high and may be associated with an increased risk of rehospitalization.**

KEY WORDS: **medical errors; continuity of care; discharge plan; discharge summary.**
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Adverse events in hospitalized patients have been associated with the discontinuity of care that occurs during the handoff of patient care from one hospital-based physician to another,[1] and there is evidence that improved communication between hospital-based physicians may decrease adverse events.[2] However, relatively little attention has been given to the spectrum of medical errors and adverse events that are caused by inadequate communication between hospital-based physicians and outpatient primary care providers (PCPs).

Physicians caring for hospitalized patients often formulate discharge plans that include medication regimens that are to be continued after discharge, scheduled outpatient tests and procedures, and test results that are pending at discharge and that need to be followed up by the outpatient PCP. The Institute of Medicine defines a medical error as "failure of a planned action to be completed as intended."[3] Based on this definition, failure to implement the intended discharge plan for a recently hospitalized patient constitutes a medical error, assuming the PCP concurs with the plan or, if not, fails to change the plan.

However, studies have shown that less than half of all PCPs are provided information about the discharge medications and plans for their recently hospitalized patients,[4–6] this despite evidence that access to relevant discharge information may be linked to improved outcomes. Van Walraven et al. demonstrated this when they showed a trend toward decreased rehospitalizations for patients that were assessed by PCPs who had access to their discharge summaries.[7] Similarly, Diem et al. showed that discharged patients seen as outpatients by the same physicians who had cared for them in the hospital had fewer emergency room visits within 1 month after discharge.[8]

We conducted this study to determine the prevalence of outpatient medical errors caused by failure to implement the intended discharge plans for recently hospitalized patients, and to assess whether these errors are associated with increased rehospitalizations.

METHODS

Study Setting and Population

Our institution is a 950-bed urban teaching hospital located on the boundary between the upper East Side of Manhattan and East Harlem. The ethnic makeup of the community is 56% Hispanic and 35% African American. The hospital has an affiliated adult primary care practice located adjacent to the main hospital that is staffed by 25 full-time attendings and 128 internal medicine residents. PCPs (attendings and residents) at the primary care practice do not assume the primary responsibility for care of their hospitalized patients. Inpatient physician staffing is based on a hospitalist model in which both attendings and residents have dedicated ward time in which they spend blocks of time during the year caring for patients on the hospital's medicine service. The attendings who are

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Address correspondence and requests for reprints to Dr. Moore: Division of General Internal Medicine, Mount Sinai School of Medicine, 1470 Madison Ave., New York, NY 10029 (e-mail: carlton.moore@mssm.edu).

currently doing their ward month are responsible (along with residents) for patient care during the hospital stay. PCPs at the affiliated primary care practice are not routinely notified of their patients' hospitalizations, and discharge summaries are not normally sent to PCPs in the primary care practice or placed in the outpatient chart.

The study participants were patients who had been discharged by their hospital-based physicians and who had a subsequent visit with an outpatient PCP within 2 months after discharge. We enrolled study participants by retrospectively reviewing the medical records of 366 randomly selected patients chosen from among the 2,139 patients discharged from the medicine service between July 2000 and June 2001. The 366 patients were randomly selected from the 2,139 patient records in an administrative database by assigning each record a unique random number and selecting patients in ascending order based on the assigned number. After querying the outpatient primary care administrative database, we found that 86 of the 366 patients were subsequently seen at the affiliated primary care practice within 2 months after hospital discharge. All of the outpatient PCPs in the study were either attending or resident physicians practicing in the affiliated primary care practice. Patients were excluded if they had an emergency room or a subspecialty visit after discharge and prior to their first postdischarge PCP visit.

Data Collection

Using a standardized chart abstraction form, 2 investigators collected the following information from the study participants' inpatient medical records: 1) demographic characteristics; 2) discharge medications; 3) tests pending at time of discharge; and 4) scheduled or suggested tests or procedures that should be followed up by the outpatient PCP. The 2 investigators then abstracted the following information from the outpatient records relevant to the first postdischarge visits: 1) current medications; 2) documentation of test results that were pending at the time of hospital discharge; and 3) documentation of outpatient tests or procedures that were suggested or scheduled at the time of hospitalization. All reviewers were blinded to the outcome (rehospitalization).

Rehospitalizations within 3 months after the first postdischarge PCP visit were ascertained by querying the hospital's administrative database.

This study was approved by the local Institutional Review Board.

Factors and Outcomes of Interest

The presence or absence of the following categories of medical errors related to the discontinuity of care from the inpatient to the outpatient setting was assessed for each participant:

1. Medication Continuity Errors: A medication continuity error occurred if a discharge medication was documented in the hospital chart, but not in the medication list of the first post-discharge PCP visit (e.g., a patient with a newly diagnosed deep vein thrombosis is discharged on warfarin, but warfarin is not documented in the outpatient chart). Over-the-counter medications, antibiotic regimens completed before the follow-up visit, and other short-term drug regimens were excluded from the analysis (Fig. 1).
2. Test Follow-up Errors: A test follow-up error occurred if a test result was pending at discharge, but was not acknowledged in the outpatient chart (e.g., a patient hospitalized with a cough and fever has a sputum acid-fast bacilli culture pending at the time of discharge; however, there is no documentation of the test result by the outpatient PCP; Fig. 2).
3. Work-up Errors: A work-up error occurred if an outpatient test or procedure suggested or scheduled by the inpatient provider was not adequately followed up by the outpatient provider (e.g., a colonoscopy for a positive fecal occult blood test is scheduled at discharge, but there is no acknowledgment of the work-up in the outpatient chart). The outpatient chart was reviewed for either 1) documentation that the work-up was initiated or completed, or 2) documentation that the outpatient PCP did not believe that the proposed work-up was indicated. If this documentation was not found, then a work-up error was considered to be present (Fig. 3).

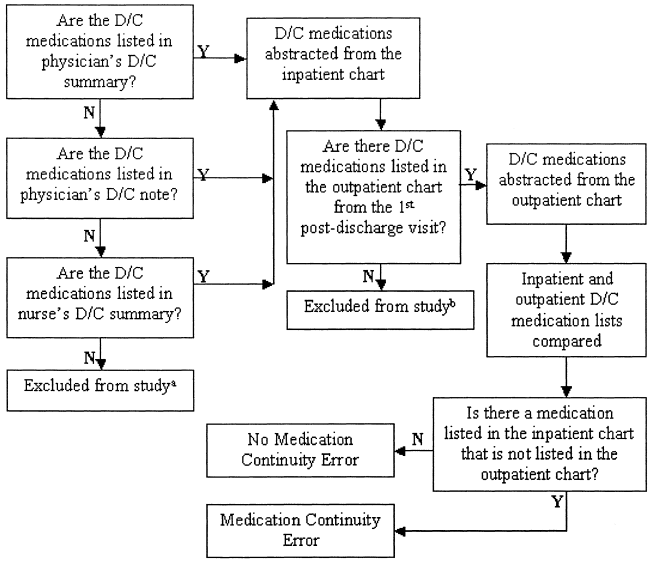

FIGURE 1. Medication continuity error chart abstraction algorithm. D/C, discharge. [a]No patients excluded from the study. [b]One patient excluded from the study.

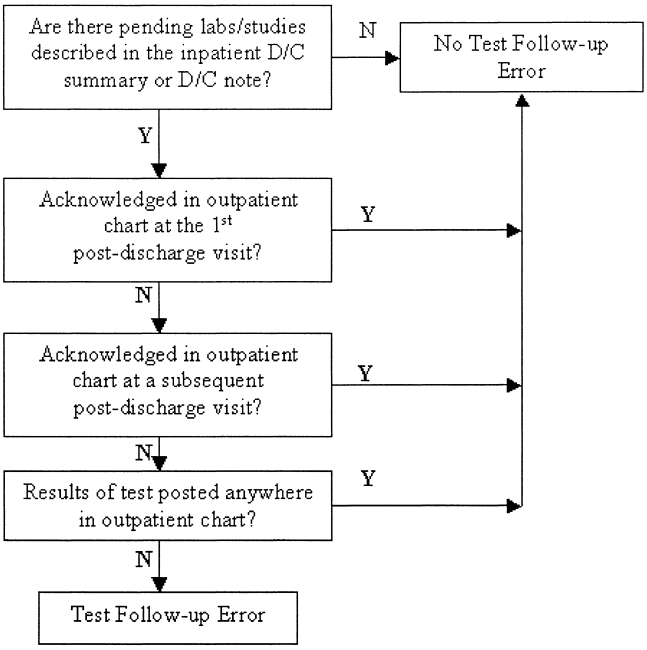

FIGURE 2. Test follow-up error chart abstraction algorithm. D/C, discharge.

Reliability Appraisals

Two investigators independently reviewed 20 randomly selected sets of inpatient and outpatient medical records in order to assess inter-rater reliability for the presence or absence of the 3 categories of medical errors. The κ statistics were 0.88, 0.64, and 0.82 for medication continuity errors, test follow-up errors, and work-up errors, respectively, indicating good to very good inter-rater reliability.[9]

Data Analysis

Univariate analysis was performed using the χ^2 test for proportions and the pooled *t* test for continuous variables. Logistic regression was used to examine the association between the 3 categories of medical errors and the presence of at least 1 hospitalization within 3 months after the first postdischarge PCP visit.

Many variables may influence rehospitalization[7]; therefore, we collected data about potential confounders for each patient. The regression model adjusted for the following clinical covariates: age; sex; ethnicity; number of diagnoses; length of hospitalization; number of discharge medications; number of tests pending at discharge; number of outpatient work-ups suggested in the inpatient medical record; time from discharge to outpatient PCP visit; PCP status (attending, intern, 2nd year resident, 3rd year resident); inpatient-outpatient PCP continuity; whether the patient was new to the outpatient PCP; and type of insurance. We used the backward likelihood ratio method in which variables were removed one at a time using the criteria of a *P* value >.2. *P* values of <.05 were considered to be statistically significant. SPSS 10.0 for Windows version 10.0.5 (SPSS Inc., Chicago, Ill) was used for all statistical calculations.

RESULTS

Baseline patient characteristics are shown in Table 1. The mean patient age was 58 years, 58% were female, and 85% were either black or Hispanic. The mean length of hospitalization was 4.2 days (range 1–19) with a mean time from hospital discharge to outpatient follow-up of 17 days (range 1–61). Thirty-two percent of patients were rehospitalized within 3 months after the first postdischarge PCP visit.

Of the 86 patients studied, 49% (95% confidence interval [95% CI], 39 to 60) had experienced 1 or more of the 3 categories of medical errors related to the discontinuity of care from the inpatient to the outpatient setting (Table 2). Forty-two percent (95% CI, 32 to 52) of patients had at least 1 medication continuity error. The classes of medication most commonly involved were cardiovascular (36.4%), gastrointestinal (27.3%), and pulmonary (13.6%). Fifty percent of the cardiovascular medications were antihypertensives, and 12.5% were anticoagulants (warfarin) for patients with atrial fibrillation. The most common gastrointestinal medications were proton pump inhibitors and histamine-2 antagonists. All of the pulmonary medications were for the treatment of asthma.

Eight percent (95% CI, 2 to 14) of all participants, and 41.2% of participants with tests pending at discharge, had at least 1 test follow-up error (Table 3).

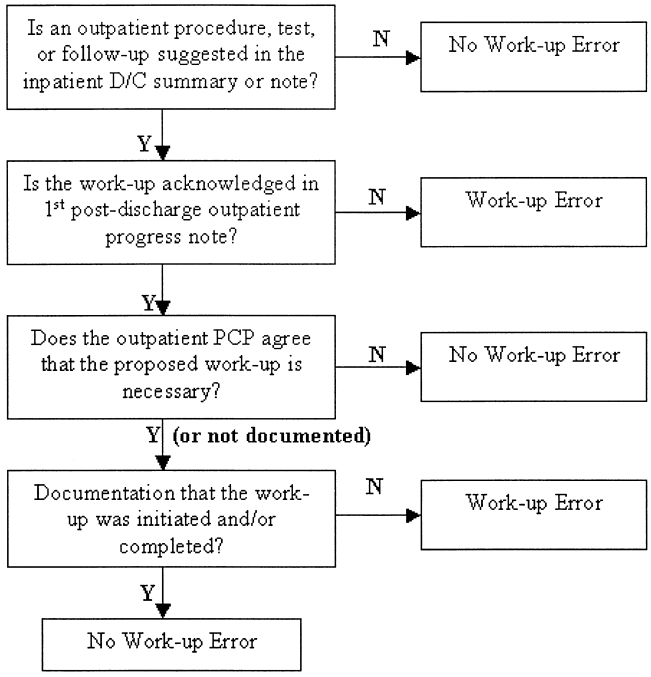

FIGURE 3. Work-up error chart abstraction algorithm. D/C, discharge.

Table 1. Demographics and Clinical Characteristics of the Study Population

Characteristics	Patients (*N* = 86)
Mean age, y (range)	58 (24 to 96)
Female gender, %	58
Ethnicity, %	
Hispanic	50.0
Black	34.5
White	8.3
Other	7.2
Mean length of hospitalization, d (range)	4.2 (1 to 19)
Mean discharge medications, *n* (range)	5.9 (0 to 13)
Patients with tests pending at the time of discharge, %	19.8 (17/86)
Mean tests pending at the time of discharge, *n* (range)	0.31 (0 to 5)
Patients discharged with planned outpatient work-ups, %	52.3 (45/86)
Mean planned outpatient work-ups, *n* (range)	0.79 (0 to 4)
Mean diagnoses, *n* (range)	3.5 (1 to 8)
Mean time to 1st postdischarge PCP visit, d (range)	17 (1 to 61)
Patients hospitalized within 3 mo after 1st postdischarge PCP visit, %	32

Twelve percent (95% CI, 5 to 19) of all patients, and 22.2% of patients with a planned outpatient work-up, had at least 1 work-up error. Forty-five percent of the work-up errors involved failure to follow up on a planned outpatient work-up for gastrointestinal or gynecological bleeding (Table 4).

Covariates remaining in the final regression model were age, gender, race, length of hospitalization, and the number of discharge medications. Multivariate analysis showed that patients with at least 1 work-up error were 6.2 times (95% CI, 1.3 to 30.3) more likely to be rehospitalized within 3 months after the first postdischarge PCP visit compared to patients with no work-up errors. We did not find a statistically significant association between medication continuity errors (odds ratio [OR], 2.5; 95% CI, 0.7 to 8.8) or test follow-up errors (OR, 2.4; 95% CI, 0.3 to 17.1) with rehospitalizations.

DISCUSSION

We describe 3 categories of medical errors caused by failure to implement the intended discharge plans for recently hospitalized patients. Specifically, the medical errors defined in this study are best termed continuity of information[7,10] errors in that relevant information concerning the intended discharge plan was not adequately transmitted from the hospital-based provider to the outpatient PCP. To our knowledge, this is the only study to investigate the prevalence of these types of medical errors and their potential association with adverse patient outcomes.

Almost half of all patients in our study sample had at least 1 medical error related to the discontinuity of care from the inpatient to the outpatient setting, with a significant association between the presence of a work-up error and an increased likelihood of rehospitalization within 3 months after the first postdischarge PCP visit.

Our study was not powered to investigate how work-up errors potentially affect rehospitalizations. Ideally, one would want to document a causal relationship between the work-up errors that we found and the subsequent rehospitalizations. The inter-rater reliability among physicians using medical record review to identify adverse events caused by medical errors has been found to be poor to moderate; and researchers therefore should use caution when interpreting these data.[11,12] Given the aforementioned caveat, we hypothesize that the increased risk of rehospitalization for patients who experience work-up errors may, in part, be due to patients' intended outpatient work-ups not being implemented. For example, a 60-year-old woman in our study with a history significant for asthma and hypertension was hospitalized with the

Table 2. Prevalence of Medical Errors in the Study Population

Type of Error	Prevalence, %	95% Confidence Interval
Medication continuity errors	42	32 to 52
Work-up errors	12	5 to 19
Test follow-up errors	8	2 to 14
Any medical error	49	39 to 60

Table 3. Test Follow-up Errors

Patient	Test(s)	Indication
#1	HIV test, viral hepatitis serologies	Worsening renal function
#2	Pleural fluid cytology	Rule-out malignancy
#3	Stool culture	Rule-out bacterial diarrhea
#4	Thyroid function tests	History of hypothyroidism
#5	Helicobacter pylori titers	Dyspepsia, abdominal pain
#6	ANCA titers, ASO titers	Nephrotic syndrome
#7	Throat culture, cryoglobulins	Skin biopsy showing vasculitis

ANCA, antineutrophil cytoplasmic antibody; ASO, antistreptolysin O antibody.

Table 4. Work-up Errors*

Type of Work-up	Indication	Frequency
Gastrointestinal	Gastrointestinal bleeding	3
Gynecologic	Vaginal bleeding	2
Psychiatric	Opiate/benzodiazapine addiction	2
Pulmonary	Abnormal chest radiograph	1
Urology	Hematuria	1
Cardiology	Chest pain	1
Oncology	Rule-out malignancy	1

* *A total of 11 work-up errors occurred in 10 patients.*

diagnosis of asthma exacerbation. Her symptoms of dyspnea and wheezing began improving on a steroid taper and she was subsequently discharged home with a planned outpatient work-up for an abnormal admission chest radiograph significant for a diffuse reticular nodular pattern consistent with an interstitial process. The outpatient work-up that was to include a computed tomography (CT) scan of the chest and an appointment with a pulmonologist was not implemented, and the planned work-up was never mentioned in the chart by the outpatient PCP who evaluated the patient 2 weeks after discharge. The patient was rehospitalized approximately 1 month later complaining of worsening shortness of breath. During the rehospitalization, a CT tomography scan of the chest was obtained and the results were significant for bilateral hilar adenopathy and numerous apical nodular densities consistent with sarcoidosis, although a neoplastic process could not be excluded. In this example, it is unclear if the rehospitalization would have been prevented if the patient had been diagnosed and treated during the planned outpatient work-up; therefore, a determination of any causal relationship is clearly subject to interpretation. In reviewing the medical records of patients in our study who had both a work-up error and a rehospitalization, we found that in 3 of 6 cases, the work-up error may have contributed directly to the rehospitalization. Once again, our sample size was extremely small and our methods for determining causality were not rigorous. Future research with a large sample size and use of high confidence scores to indicate the presence of an adverse event caused by a work-up error is needed to establish a possible causal relationship.

We did not find an association between medication continuity errors or test follow-up errors with rehospitalizations. However, many of the medication continuity errors and test follow-up errors in our study were likely not severe enough to result in a rehospitalization. For example, 50% of the cardiovascular medication continuity errors involved antihypertensive medications. While this sort of error may cause an elevation in the patient's blood pressure, it is not likely to result in a rehospitalization; thus, the study may not have been powered to detect such an association. Ghandi et al. showed that 48% of patients reporting outpatient drug complications sought medical help.[13] These complications may be associated with emergency room or urgent care visits, but do not necessarily lead to rehospitalizations.

A limitation of this study is that we relied on documentation in the outpatient chart in order to establish the presence or absence of a medical error related to the discontinuity of care from the inpatient to the outpatient setting. This methodology potentially overestimated the prevalence of medical errors in that a given PCP may have been aware of a patient's discharge regimen, tests pending at discharge, or suggested outpatient work-ups, and not have documented this fact in the outpatient chart, or (perhaps for good reason) may have chosen not to follow the intended discharge plan. One way of addressing this deficiency is to modify the medical error definitions to allow for exceptions when the documented outpatient management can be reasonably justified given the findings documented at the postdischarge visit. For example, if a patient is discharged from the hospital on an antihypertensive medication and is subsequently found to be normotensive at the postdischarge PCP visit despite being nonadherent with the medication, it should not be considered a medical error if the PCP does not restart the antihypertensive. However, the tradeoff for using clinical judgment to improve the specificity of the algorithms used to determine the existence of these discontinuity errors is likely a decrease in inter-rater reliability, since physician reviewers will likely have varying thresholds for the outpatient managements that they consider "reasonably justified."

The prevalence of medication continuity errors in our sample (42%) is similar to the percentage of patients found to be nonadherent with their intended discharge medication regimens by other investigators (approximately 50%).[14,15] Therefore, the PCPs in our study may be accurately documenting what the patient is currently taking, while being unaware that the current regimen is a significant departure from the intended discharge regimen.

Although we controlled for many important factors, our observational study could not control for all potential confounders. For example, physicians whose patients had a work-up error may be systematically different in the way they manage their patients compared with physicians whose patients did not have a work-up error.

Another limitation of our study is that it was done at a single institution with a hospitalist model for inpatient physician care and with outpatient PCPs who had no access to patients' discharge summaries. Despite this limitation, our findings have important implications given the growing prevalence of the hospitalist model as a recent organizational innovation in health care.[10,16] Studies have shown significant improvement in outcomes with implementation of the hospitalist model.[17–24] However, some investigators have expressed concern that this comes at the expense of inpatient-to-outpatient continuity of care and that, as a result, patient care during the immediate postdischarge period may suffer.[10,25–28] We believe that the hospitalist model combined with the poor dissemination of discharge information to outpatient PCPs create an environment in which the discontinuity errors described in this article become relatively common. This is consistent with the Institute of Medicine's assessment that poor processes of care, and not the actions of individual providers, are primarily responsible for medical errors.[3]

Our patient population was overwhelmingly black and Hispanic (85%) with largely Medicaid and Medicare insurance coverage (96%). Factors influencing the prevalence of medical errors related to the discontinuity of care from the inpatient to the outpatient setting may differ for other populations. For example, there are racial, ethnic, and sociodemographic differences in the use of teaching hospitals,[29] outpatient PCP continuity,[30] and preventable hospitalizations,[31] all of which may influence the

prevalence of the medical errors described in this study. We believe that further research is warranted in order to determine if there are racial, ethnic, and sociodemographic differences in the prevalence of these errors.

Finally, the severity of the medical errors identified in the study was not described. As a result, no distinction was made between a medication continuity error involving a drug prescribed to treat a relatively benign ailment, and one prescribed to treat a disease with a high morbidity and mortality. Future efforts should concentrate on developing a reproducible measure of medical error severity based on the potential of the error to result in an adverse event, which could then be applied to determine if there is an association between moderate-to-severe medical errors and adverse patient outcomes.

Our findings linking the discontinuity of care from the inpatient to the outpatient setting to adverse outcomes has important implications for clinicians. Historically, the hospital discharge summary has been the most common method for the dissemination of patient-specific information from hospital-based providers to outpatient PCPs[32] and its receipt by PCPs may be linked to improved patient outcomes.[7] Future studies should focus on investigating how receipt of discharge summaries by PCPs influence the discontinuity errors described in this study. If an association is shown, interventions focused on improving the timely dissemination of hospital discharge summaries to outpatient PCPs may be designed specifically to decrease discontinuity errors and improve the quality of patient care.

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